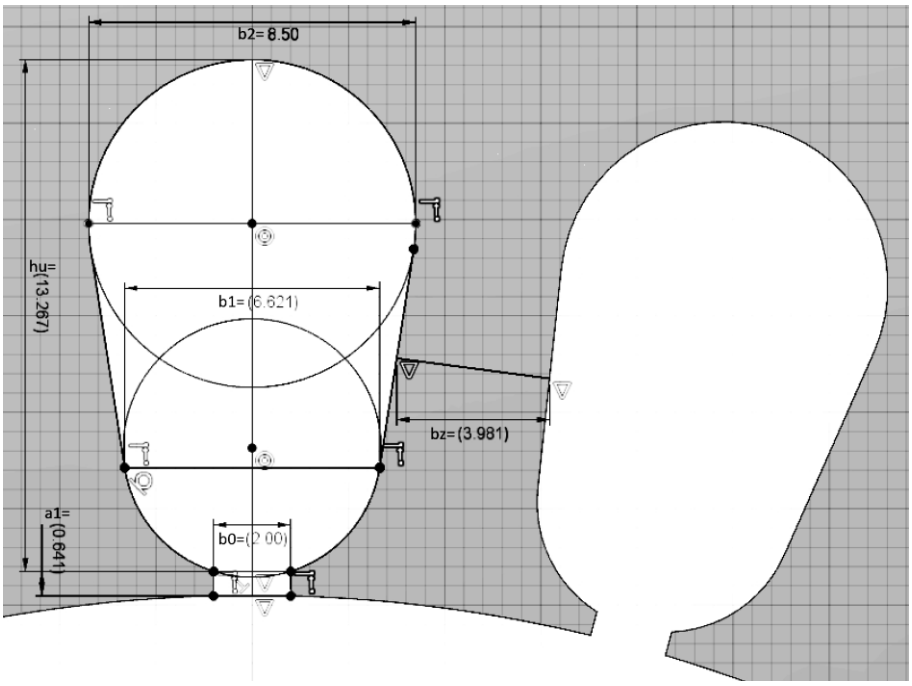


length of stators package: $lp = 87\ mm$.
External diameter of stator package: $Da = 128\ mm$.
Inner diameter of stators package: $Di = 75{,}5\ mm$.
Number of stators slots: $Z = 24$

Width of stators slot: $b_1 = 6{,}621\ mm$.
$b_2 = 8{,}5\ mm$.
Height of stators slot: $hu = 13{,}267\ mm$.
Opening of stator's slot: $b_0 = 2\ mm$.
Height of slots "neck": $a_1 = 0{,}641\ mm$.
Tooth width: $bz = 3{,}981\ mm$.

$$2p = \frac{120 \times f}{n} = \frac{120 \times 50}{3000} = 2$$

$2p$ – number of poles, f – nominal frequency (Hz), n – rotation of magnetic field (turns/min).

$$\tau = \frac{\pi \times Di}{2p} = \frac{3{,}14 \times 75{,}4}{2} = 118{,}53\ mm.$$

τ – pole step, Di – inner diameter of stator package (mm.), $2p$ – number of poles, "π" - number "pi" = 3,14

$$Qp = \tau \times lp = 118{,}53 \times 87 = 10312{,}11\ mm^2 = 103{,}12\ cm^2$$

Qp – surface of pole (cm^2), τ – pole step, lp – length of stator package, mm.

kz – iron filling factor	thickness of lamella in mm.	type of isolation		no isolation
		lacquer	phosphate	
	0,50	0,90	0,92	0,94
	0,65	0,92	0,94	0,96

$$lz = kz \times lp = 0{,}92 \times 87 = 80{,}04\ mm.$$

lz – clean iron length, mm., kz – iron filling factor, lp – length of the stator package, mm.

$$hz = hu + a_1 = 13{,}267 + 0{,}641 = 13{,}908\ mm.$$

hz – tooth length, hu – heigth of stator slot, a_1 – height "neck" of slot.

$$hy = 0{,}5 \times (Da - Di - 2 \times hz) = 0{,}5 \times (128 - 75{,}5 - 2 \times 13{,}908) = 12{,}342\ mm.$$

hy – height of the yoke, Da – external diameter of stators package, Di – inner diameter of stators package, hz – tooth length. Stators yoke is part of stators package which extends from stators bottom slot to external diameter of package.

$$Qy = hy \times lz = 12{,}342 \times 80{,}04 = 987{,}85\ mm^2 = 9{,}88\ cm^2$$

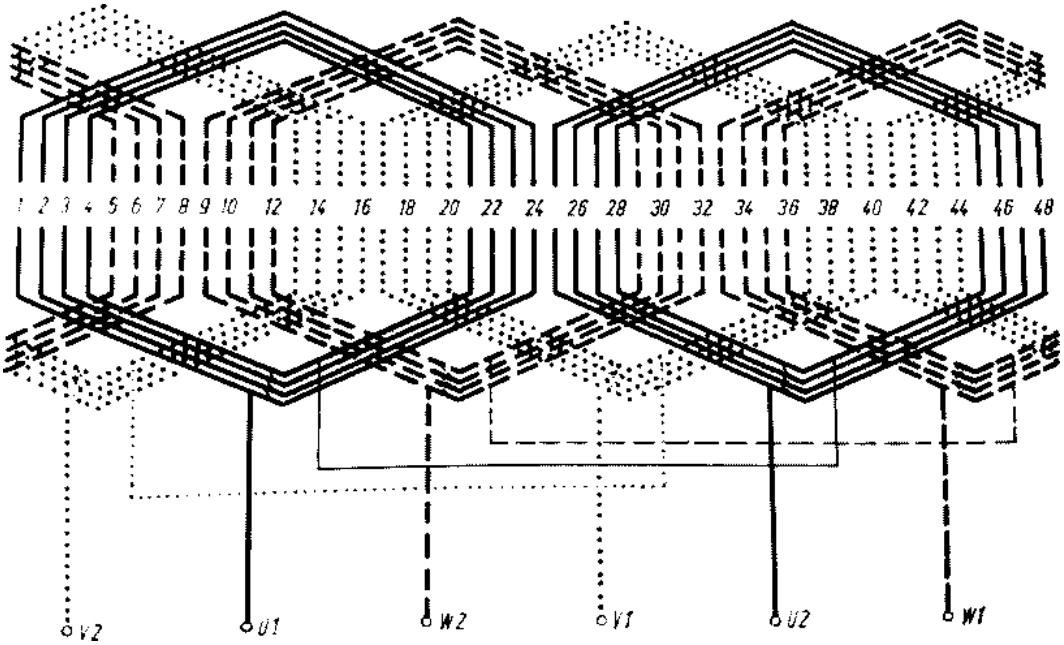
Qy – yoke cross section (mm^2 or cm^2), hy – yoke height, $mm.$, lz – clean iron length, mm.

$$Qz = \frac{Z \times bz \times lz}{2p} = \frac{24 \times 3{,}981 \times 80{,}04}{2} = 3823{,}671\ mm^2 = 38{,}237\ cm^2$$

Qz – one pole tooth cross section (cm^2), Z – number of stator's slots, bz – tooth width, lz – clean iron length, $2p$ – number of poles.

$$Qs = \frac{\pi}{8} \times (b_1^2 + b_2^2) + \frac{h}{2} \times (b_1 + b_2) = \frac{3{,}14}{8} \times (6{,}621^2 + 8{,}5^2) + \frac{6{,}33}{2} \times (6{,}621 + 8{,}5) = 93.4\ mm^2$$

Qs – slot surface (mm^2), b_1 – slot width 1, b_2 – slot width 2, h – distance between slot circles (watch picture of gaps in previous steps).



$$q = \frac{Z}{2p \times m} = \frac{24}{2 \times 3} = 4$$

q – number of slots per pole and phase, Z – number of slots, $2p$ - number of poles, m – number of phases of winding.

$$\tau = \frac{Z}{2p} = \frac{24}{2} = 12$$

τ – pole step, Z – number slots, $2p$ – number of poles.

q	1	2	3	4	5	6	7	8
ξz	1	0,966	0,960	0,958	0,957	0,956	0,956	0,955

$$\xi = \xi z \times \xi t$$

ξ – winding factor, ξz – shortening winding factor, ξt – distribution winding factor.

Calculation of the Induction in the Stator Yoke.

Select appropriate value of induction in air gap from table. It depends on number of pole pairs. If motor is older chose column I, else chose value from column II.

$2p$	Bag ($Tesla$)		By	Bz
	I	II		
2	0,6 – 0,7	0,75 – 0,85	1,6 – 2,1	1,0 – 1,6
4	0,65 – 0,75	0,8 – 0,9	1,5 – 2,0	1,2 – 1,7
6	0,65 – 0,75	0,8 – 0,9	1,5 – 1,9	1,3 – 1,7
8	0,7 – 0,8	0,8 – 0,9	1,5 – 1,9	1,3 – 1,7
10	0,7 – 0,8	0,8 – 0,9	1,5 – 1,9	1,3 – 1,7

$$Bz = Bag \times \frac{Qp}{Qz} = 0{,}65 \times \frac{103{,}12}{38{,}237} = 1{,}753\ T$$

Bag – induction in air gap, *By* – induction in yoke, *Bz* – induction in teeth of stator, , *Qp* – surface of pole, *Qz* – cross section of the tooth.

$$By = \frac{Bag \times Qp}{\pi \times Qy} = \frac{0{,}65 \times 103{,}12}{3{,}14 \times 9{,}88} = 2{,}15\ T$$

By – indiction in stator yoke, *Bag* – induction in air gap, *Qp* – surface of pole, *Qy* – cross section of yoke.

$$\Phi = \frac{Bag \times Qp \times 10^{-4}}{1{,}57} = \frac{0.65 \times 103{,}12 \times 10^{-4}}{1{,}57} = 0{,}00427\ Wb$$

Φ – magnetic flux of one pole pair (*Wb, weber*), *Bag* – induction in air gap (*Tesla*), *Qp* – pole surface (cm^2).

$$w' = \frac{0{,}22 \times U \times a}{\Phi \times f \times \xi} = \frac{0{,}22 \times 230 \times 1}{0{,}00427 \times 50 \times 0{,}958} = 247{,}39 \approx 247$$

w' – calculation number of turns in phase, *U* – phase voltage (V), *a* – number of parallel branches, *Φ* – magnetic flux of 1 pole pair, *f* – nominal frequency (Hz), *ξ* – winding factor.

$$S'u = \frac{6 \times w'}{Z} = \frac{6 \times 247}{24} = 61{,}75 \approx 62$$

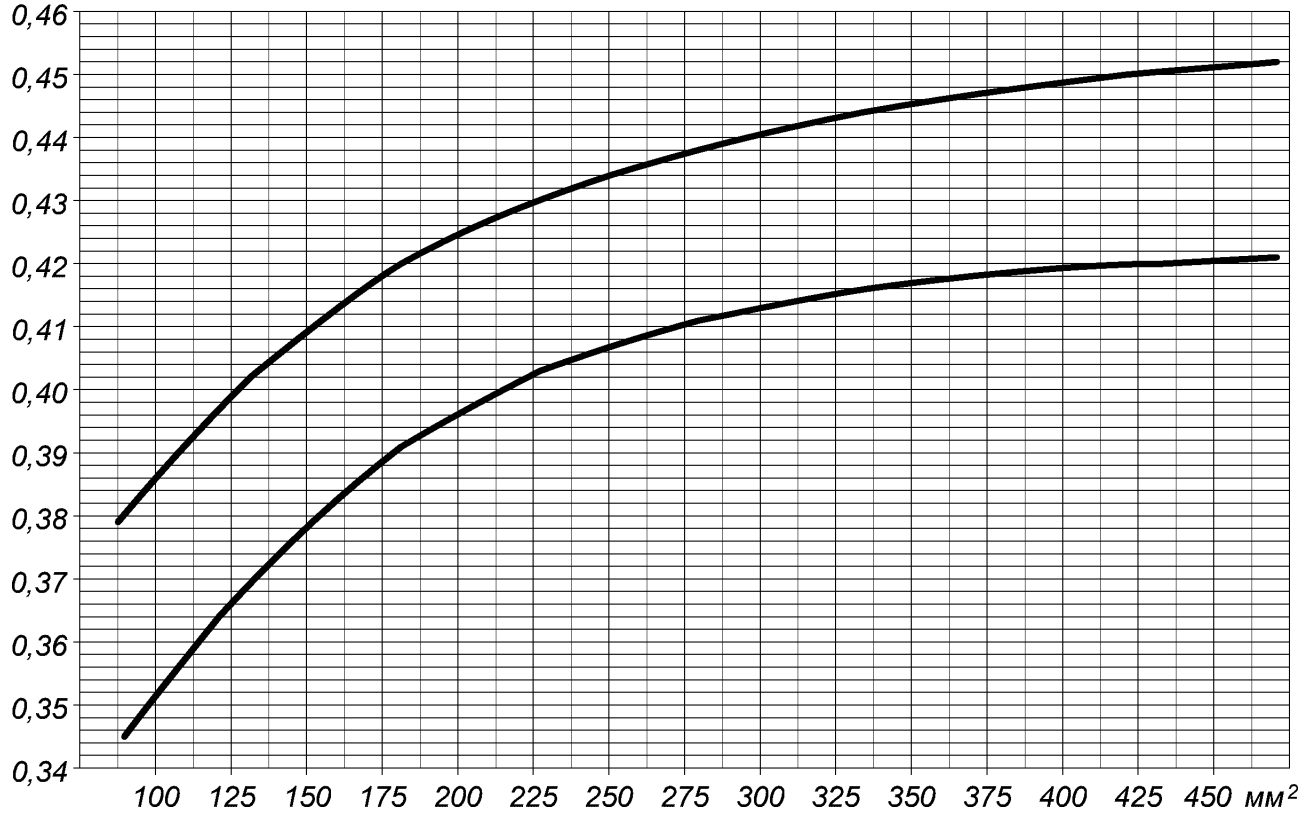
S'u – calculation number of turns in slot, *w'* – calculation number of turns in phase.

$$qv = \frac{Qs \times fu}{Su} = \frac{93{,}4 \times 0{,}34}{62} = 0{,}512\ mm^2$$

qv – cross section of the wire with isolation, *Qs* – surface of slot, *fu* – filling factor, *Su* – number of turns in slot.

$$dz = 2 \times \sqrt{\frac{qv}{\pi}} = 2 \times \sqrt{\frac{0{,}512}{3{,}14}} = 0{,}807\ mm$$

qv – cross section of the wire (*mm*), *dz* – insulated wire diameter (*mm*).



Filling factor in depend section of slot.

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